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## TOBACCO CULTURE

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**T**OBACCO leaf when cured is classified as cigar tobacco, export tobacco, or manufacturing tobacco, and each class is divided further into types, according to characteristics and appropriate use.

Differences in soil and climate have great influence upon the quality of tobacco leaf, and particular types, therefore, are grown chiefly in certain well-defined areas. New types are not in demand, and efforts to introduce tobacco culture in new sections are not likely to succeed.

This bulletin indicates the areas in which the different types are produced. It gives the necessary details regarding the varieties of seed to be used and the methods of growing the seedlings, transplanting to the field, fertilizing, cultivating, caring for, and harvesting the crop in each of the more important tobacco-growing regions.

# TOBACCO CULTURE

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## CONTENTS

	Page		Page
Localization of tobacco production.....	1	Tobacco diseases .....	18
Classes and types of tobacco.....	2	Insect enemies of tobacco.....	22
The culture of cigar tobaccos.....	2	Selecting seed plants and saving the seed.....	22
The culture of the export and manufacturing types.....	11		

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## LOCALIZATION OF TOBACCO PRODUCTION

THE tobacco plant may be grown successfully in all latitudes from southern Canada to the Tropics and on a great variety of soils, but the commercial value of the product is influenced to a greater degree by the particular soil and climatic conditions under which the plant is grown than is almost any other important crop. These facts are so well recognized that the tobacco industry has become highly specialized, and the trade regularly looks to certain well-defined areas of production for its supply of the various classes and types of leaf required. In these tobacco-producing districts the necessary facilities for marketing are available, and prevailing prices of the cured leaf are governed largely by the relative supply and demand and by the quality of the leaf produced.

Each important district produces a tobacco of certain well-known characteristics which make it desirable for special purposes of manufacture or export. Moreover, in practically all of these districts the production can be readily increased to meet any increased demand at profitable prices. For these reasons efforts to introduce the commercial growing of tobacco in sections outside of the established producing centers are likely to result in failure, either because the leaf produced is not quite right in type or satisfactory marketing facilities are not available. Furthermore, any development of the industry in a new section on a large scale, which would be essential for economical marketing, would most likely lead to overproduction and, as a consequence, unprofitable prices. As a matter of fact, overproduction is a constant menace in all of the established centers of tobacco growing.

The methods of growing and handling the crop must be varied according to the type of leaf which it is desired to produce, for the kind of tobacco obtained is influenced very greatly by the methods of growing and handling which are employed. The methods for the production of the various types briefly outlined in the present bul-

letin, though possibly susceptible of improvement in some of the details, are the best that can be recommended in view of the present knowledge and experience of investigators and the more successful growers.

## CLASSES AND TYPES OF TOBACCO

As is well known, tobacco is manufactured into various forms for consumption, but large quantities also are exported in an unmanufactured state, so that we may distinguish three general classes of tobacco, i. e., (1) cigar tobaccos, (2) export tobaccos, and (3) manufacturing tobaccos. By manufacturing tobaccos are meant all types used in manufactures other than cigars. The manufacturing and export classes, however, have much in common as regards cultural methods, and some types are used both for manufacturing and for export; therefore these two classes will be considered together as distinguished from the cigar tobaccos.

Each of these three classes of tobacco may be subdivided into types, depending on their special uses, methods of growing and curing, or on the variety of seed used. In the case of cigar tobaccos there are three principal types, corresponding to the three parts of the cigar—wrapper leaf, binder leaf, and filler leaf. In the manufacturing and export tobaccos are such types as the flue-cured, Virginia sun-cured, White Burley, dark fire-cured, etc. These various types are produced on certain special types of soil and according to definite methods of growing, curing, and handling the crop. In some cases the variety of seed used is also an important factor. The special uses of the principal types embraced in the three fundamental classes of tobacco are brought out in connection with the cultural directions for the more important types.

## THE CULTURE OF CIGAR TOBACCOS

While cultural methods in their application to the different cigar-tobacco types and districts may be modified to advantage in some of the details, the essential features are more or less similar, so that it will suffice to outline the most approved methods for the Connecticut Valley, and only the more important differences in cultural methods to be followed in the remaining districts need be mentioned.

### CIGAR-LEAF TOBACCO VARIETIES

There are three important varieties or groups of varieties used in growing cigar tobaccos in this country, i. e., the Broadleaf or Seedleaf group, the Havana Seed group, and the Cuban group. The typical Broadleaf or Seedleaf is the Connecticut Broadleaf, extensively grown in the Connecticut Valley for binders and wrappers. Acclimated strains of this variety have been developed and are grown in all the northern cigar-leaf States for the production of binder and filler leaf, and in each case these strains are given the name of the State in which they are grown. Thus, we have the Pennsylvania Broadleaf, or Seedleaf; the Ohio Broadleaf, or Seedleaf, etc.

The Connecticut Havana, or Havana Seed, also is extensively grown in the Connecticut Valley for wrapper and binder leaf pur-

poses, and in other northern cigar-tobacco districts for binder leaf, and to some extent for filler leaf. The name "Havana Seed" usually is applied to this variety as grown in any of the northern cigar-tobacco districts, but it is preferable in each case to prefix the name of the State in which it is grown, as is done with the Broadleaf group. There is an important group of so-called Spanish varieties, extensively grown for binder and filler leaf purposes, which are very closely related to or identical with the Havana Seed. The two most important members of this group are Zimmer Spanish, principally grown for filler in the Miami Valley of Ohio, and the Comstock Spanish, chiefly grown for binder leaf in Wisconsin. Zimmer Spanish as grown in Ohio is markedly different in quality from Connecticut Havana as grown in New England, but when the two are grown side by side it is practically impossible to distinguish the one from the other.

Another variety of some local importance in the Miami Valley of Ohio is known as "Little Dutch," of which there are several strains. This variety, which relatively is narrow leaved, is thought to have been introduced from Germany.

The Cuban group is composed of strains or selections obtained from imported seed. Seed imported from Cuba is usually found to be composed of several distinct subvarieties. The Cuban is the most important variety in the southern cigar-tobacco districts, although Connecticut Round Tip and Sumatra are grown to some extent for wrapper and filler, respectively. In the Connecticut Valley a considerable acreage of Cuban tobacco for the production of wrapper leaf is grown under an artificial shade of cloth.

#### CIGAR WRAPPER AND BINDER TYPES

The Connecticut Valley and the area centering around Gadsden County, Fla., and Decatur County, Ga., are the principal wrapper-leaf sections, while Wisconsin is typically a binder-producing State. The Big Flats district of New York and Pennsylvania also produces mainly a binder leaf. The wrapper-leaf soils of the Connecticut Valley and Florida are of the sandy and sandy-loam types, containing only a very small percentage of clay and having a very limited capacity for holding water. The subsoils are chiefly sandy or sandy loam in character, containing at most only moderate amounts of clay. The binder-leaf soils of Wisconsin are sandy loams, light clay loams, and the prairie soils, which are dark, rich loams.

#### CONNECTICUT HAVANA SEED

##### PREPARATION AND CARE OF THE SEED BED

The young plant is developed from the seed in a coldframe until it has reached a convenient size for transplanting. A convenient width for the seed bed is 6 feet, and it should be of sufficient length to give the required area, 180 square feet being sufficient to produce plants for 1 acre. The best seed-bed soil is a loose loam of high fertility and thoroughly drained.

In the fall a liberal application of manure is plowed under. In addition, in the fall or prior to planting in the spring, a suitable fertilizer such as a 5-4-5 mixture may be applied at the rate of about 1 pound per square yard of seed bed and worked into the soil. The soil surface is worked to a state of fine tilth. If the facilities are available, the soil should be sterilized with steam to reduce to the minimum fungous diseases and the growth of weed seeds.<sup>1</sup>

The best time for sowing the beds is from the middle of March to the middle of April. It is seldom safe to set the plants in the field before the middle of May or the first of June, on account of the danger of late frosts and cold nights. From 6 to 8 weeks are required to produce plants of suitable size for transplanting to the field. If cloth instead of glass is used to cover the seed beds, 8 to 10 weeks are necessary to develop the plants to the proper size for transplanting.

The rate of sowing seed is important, for if the seeds are sown too thickly the plants will be delicate and spindling, while very thin seeding will produce short, thick-set plants, poorly suited for transplanting. The better practice is to sow at the rate of an even teaspoonful of dry seed to 100 square feet of bed area. In order to obtain an even distribution of the seed it is thoroughly mixed into 2 quarts of land plaster, finely sifted wood ashes, or bone meal. Three sowings should be made in order to insure an even distribution over the bed, the light color of the filler material serving to indicate the evenness of the distribution. The seed must be covered very lightly, and it will be sufficient to go over the bed with a roller or to pack the soil with a plank. After sowing, the beds are covered with glass or with cheesecloth.

The seed beds require careful attention, more especially those covered with glass. The beds should be maintained in a moist but not wet condition, and never should be allowed to dry. Sufficient ventilation must be given, and the temperature within the beds must not be allowed to become too high, as the plants are very liable to "burn." With glass-covered beds a cheesecloth or light canvas laid over the glass will be found an efficient aid in preventing burning, and during the night the cloth will also check radiation and tend to maintain a warmer temperature within the bed. It is a common practice to make one or more applications of nitrate of soda in water solution or solid form to the young plants to stimulate their growth, and for this purpose 5 pounds of the soda for each 100 square yards of bed may be used. The fertilizer must be washed from the leaves of the seedlings to prevent burning.

When the plants have developed from four to six leaves and are 5 to 6 inches in height, they are ready for transplanting. During the week prior to transplanting, the plants should be "hardened" by removing the cover from the beds during the greater part of the day, increasing the period each day until finally, if the weather is at all favorable, the covers should be left off entirely.

Before pulling the plants from the beds the soil should be thoroughly wetted to avoid the unnecessary breaking of the roots. The plants should be pulled from the bed separately and put into baskets or small boxes, in which they are carried to the field. They should

<sup>1</sup> See Farmers' Bulletin 996 for details regarding the steam sterilization of seed beds.

be kept cool and in a moist condition, especially at the roots. No plant that has wilted should be transplanted. Seed beds covered with glass are shown in Figure 1.

#### PREPARING AND FERTILIZING THE LAND

A rapid and uninterrupted growth is necessary to obtain the finest textured leaf, and clean and thorough cultivation is essential. Care is required in the preparation of the soil, and it should be brought to a fine tilth. Special attention must be given to the matter of fertilizing the crop, and the use of fertilizers containing chlorine is to be avoided, as this element tends to injure the burning qualities of the leaf.

In the preparation of the field 10 to 20 tons of stable manure to the acre may be plowed under, preferably in the fall. Manure is not

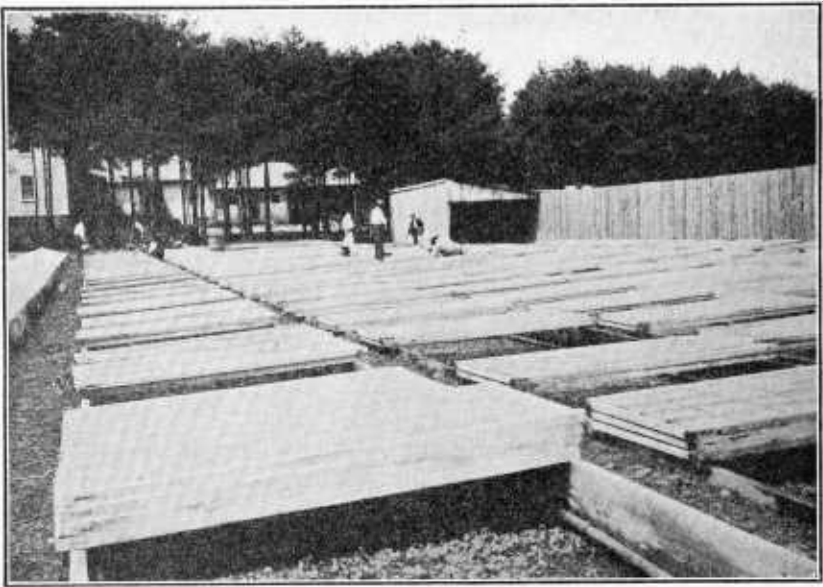


FIG. 1.—Tobacco seed beds with glass covers partly removed, showing the small seedlings.

now used so extensively as formerly and when employed at all is applied as a rule only once in every two or three years. In the spring the land is again plowed and harrowed. The fertilizers are then broadcast, this being done with a machine adapted to the purpose.

An application of fertilizer should be made, furnishing the equivalent of 1 to 2 tons per acre of a high-grade 5-4-5 mixture. As the source of nitrogen a mixture of cottonseed meal, castor pomace, and fish is used, although as much as one-third of the total nitrogen may be derived from nitrate of potash and urea or similar sources. Precipitated bone, superphosphate, and bone meal are suitable sources of phosphoric acid. The potash may be supplied from the carbonate, high-grade sulphate, sulphate of potash-magnesia, vegetable potash,



nitrate of potash, or wood ashes. Tobacco stems obtained from cigar and tobacco factories may also be used, mainly as a substitute for stable manure. Though they are to be regarded as a source of humus, the stems contain larger quantities of plant food than manure, and therefore should be applied in smaller quantities. Two tons per acre of "seed" stems (stems from cigar factories) or  $2\frac{1}{2}$  tons of "Kentucky" stems (obtained from the tobacco factories) are considered to give good results.

Formerly it was the practice also to apply lime freely to the soil, as it tends to improve the burning qualities of the leaf. Annual applications of 500 to 800 pounds per acre of burned lime or the equivalent of ground limestone have been used commonly. In view of recent work on the subject, however, it appears that the application of alkaline materials to the soil favors the development of certain fungous diseases of tobacco, especially the black root-rot; hence the use of lime is not recommended except where the soil is too acid.

Immediately before transplanting, the field should again be harrowed until all clods are broken. A smoothing harrow and plank should then be drawn over the field, after which the rows are marked off. If a transplanting machine is used, the marking off of the rows is unnecessary, as a marker on the machine can be used to gauge the position of each succeeding row.

#### TRANSPLANTING AND CULTIVATING

The plants should be set in rows 3 feet 3 inches to 3 feet 6 inches apart. In the rows the plants may be set from 14 to 20 inches apart, the best distance for average conditions being about 18 inches. The setting of the small plant requires care in order that the roots may be given an opportunity for rapid development, so that the plants may start to grow promptly. Where a transplanting machine is used the distance of setting, the application of water, and the firm establishment of the plant are automatically regulated; but when the crop is small, say an acre or less, a machine can not profitably be employed. The type of machine most used in transplanting is shown in Figure 2.

In hand setting, the method is as follows: After the rows have been marked on the field, the points at which the plants are to be set may be marked out by running along the row a light buggy wheel, with projections set on its rim at the proper intervals, or by the use of other simple devices. A hole 4 to 6 inches in depth is then made with a dibble to receive the plant. Unless the soil is already thoroughly wet, the holes are filled with water. The soil quickly puddles after the water has been applied, and the plant should be set immediately. The roots should be placed in the puddled mass and before all of the water has been absorbed by the soil. The surrounding soil is then drawn about the roots and stalk of the plant and firmly pressed, so that the plant is maintained in an erect position, allowing the bud to remain just above the surface.

If possible, transplanting should be done on a cloudy or rainy day or in the afternoon, so as to avoid excessive wilting. It requires several days for the plants to recover from the shock due to trans-

planting, but as soon as practicable all plants which have died should be replaced by healthy ones freshly drawn from the seed bed. The field should be gone over at least three times within the first two weeks, for it is important to obtain as nearly a perfect stand as possible. Damage from cutworms must be guarded against, and if they are present constant resetting during the first three weeks may be necessary.

After the field has been set about a week, cultivation should begin and should be maintained as long as the size of the plants permits. Ordinary surface cultivation to maintain a loose, fine mulch about the plant, with frequent hoeing to keep down weeds, is essential. Cultivation should be shallow, especially in the later stages of growth, to avoid injury to the roots of the plant.



FIG. 2.—Transplanting tobacco with a horse machine

When about one-half of the plants in the field have developed seed heads, but before these have bloomed, "topping" should be done.

This consists of breaking off the top or crown of the plant at about the third sucker or branch below the seed head, so as to allow the plant to develop more fully the lower leaves. After topping, suckers or lateral branches will soon develop in the axils of the leaves, and these should be removed by hand before they become large enough to retard the development of the leaves. In topping and suckering, the field must be gone over two or three times, the aim being to cause all of the plants in the field to mature at about the same time, and hence those plants developing a seed head later than the average should be topped lower.

#### HARVESTING

Either of two methods of harvesting Havana Seed tobacco may be used. The one most commonly practiced is to cut the whole plant

when the middle leaves are "ripe," i. e., when the leaves have assumed a lighter shade of green and have thickened so that upon folding a section of the leaf it creases or cracks on the line of folding. In harvesting the plants, the stalk is cut near the ground with a light hatchet, knife, saw, or a special form of long-handled shears, and the plant is carefully laid upon the ground, where it is allowed to remain until the leaves have wilted sufficiently to avoid much breaking in handling. It is then hung upon a lath 4 feet long by piercing the stalk near its base with a removable metal "spearhead" placed on the end of the lath and sliding the stalk on the lath. As a rule, six plants should be hung on a lath and distributed evenly. Instead of spearing the stalk it may be hung upon the lath by means of a hook or a nail



FIG. 3.—Harvesting tobacco by cutting the stalk, showing the method of spearing the plant on the stick

driven through the lath at a sufficient angle to hold the plant securely. Six hooks or nails are put at equal distances on the lath, the three on one side alternating with those on the opposite side. The method of harvesting by cutting and spearing the stalk on the lath is shown in Figure 3.

The laths carrying the plants should be placed upon a rack and hauled to the curing barn, where they are hung in tiers with a space of 6 to 10 inches between the laths.

In the second method of harvesting Havana Seed the leaves are picked from the plant as they ripen. The degree of ripeness is not so advanced as that described for stalk-cut tobacco. The proper degree of ripeness is very important, for upon this largely depends the development of the desirable qualities of texture, body, color, elasticity, etc., during the process of curing. A safe guide is to take the first picking at the time the seed head forms, and subsequent

pickings at intervals of six days. Five pickings should be made, the first one comprising the lower four leaves of commercial size and, proceeding upward on the plant, the second and third pickings each including three leaves, and the fourth and fifth pickings three or four leaves each. As the leaves are taken from the plant they should be laid in the row and then carried by an attendant in baskets to the curing barn. Here, by means of a large needle, a string is passed through the stem of the leaf near its base, one end of the string being attached to the end of the 4-foot lath, and when the string is full the free end is attached to the other end of the lath. Each lath should carry 36 to 40 leaves, and the leaves should be put on in pairs, so that they are back to back and face to face. The laths should be spaced 5 inches apart in the curing barn.

#### CONNECTICUT BROADLEAF

The methods of preparing the seed bed and the land are the same for Broadleaf as for Havana Seed. In setting Connecticut Broadleaf in the field, the distance between plants should be greater than in the case of the Havana Seed on account of the larger size of the leaf of the former. The best distance of setting the plants in the row is 20 to 24 inches, and the rows should be from 3 feet 3 inches to 4 feet apart, but otherwise the cultural methods to be followed are about the same as for Havana Seed. The same fertilizers are to be used as for Havana Seed. The Broadleaf should be harvested by cutting the stalk in the manner described for Havana Seed.

#### COMSTOCK SPANISH

The Comstock Spanish variety, along with the ordinary Havana Seed, is specially adapted to the production of binder leaf in Wisconsin. The seed beds should generally be sown during the latter half of April. Barnyard manure is used with good success in fertilizing the tobacco soils, but thus far commercial fertilizers have been used more sparingly than in the Connecticut Valley. Transplanting from the seed bed to the field under normal conditions should be done during June, more commonly during the latter half of the month. The rows should be 34 to 38 inches apart and the plants should be set 18 to 20 inches apart in the row. Harvesting, which is done by cutting the stalk in the manner described for Havana Seed, should begin about three weeks after topping.

#### CUBAN

Acclimated strains of Cuban Seed are grown under artificial shade in the Florida-Georgia district and in the Connecticut Valley for the production of a high-priced cigar-wrapper leaf. This phase of the industry, however, is very intensive and highly specialized, requiring the greatest skill and expert knowledge, and is largely carried on by corporations or individuals having ample capital. Cuban tobacco is also grown under ordinary conditions for cigar-wrapper purposes in the southern districts, but it is preeminently a filler variety and will be discussed more fully as such.

## CIGAR-FILLER LEAF

Our domestic cigar-filler leaf is produced mainly in the Lancaster (Pa.), the Miami Valley (Ohio), and the Onondaga (N. Y.) districts, and in restricted areas of Florida and Georgia. The best filler-leaf soils, mostly loams, are decidedly stronger than those adapted to wrapper leaf, containing more silt and clay and retaining larger percentages of water. In the main, these soils are well adapted to general farming, and the tobacco is, or should be, grown in rotation with other crops. Cultural methods differ principally from those followed in the wrapper districts, in that the plants are spaced farther apart in the field and are topped lower so as to obtain a heavier leaf, and the tobacco is allowed to become ripier before it is harvested. In general, less intensive methods are followed than in the wrapper districts, since filler leaf commands only moderate prices.

## PENNSYLVANIA BROADLEAF

The typical filler soils of the Lancaster district are the Hagerstown and the Conestoga loams, which are of limestone origin. The method of preparation and the care of the seed bed are essentially the same as in the wrapper districts. The seed usually should be sown during the first half of April, and transplanting, which is generally done with a horse transplanter, should take place through the month of June. The soil needs to be put in good condition by plowing and harrowing. Stable manure should be used liberally, usually at the rate of 10 loads or more per acre. As a supplement to the manure, a commercial fertilizer consisting of about 500 pounds of cottonseed meal, 300 pounds 16 per cent superphosphate, and 100 to 200 pounds sulphate of potash per acre, or other similar mixture, usually will improve both the yield and the quality of the crop. The rows should be 3 to 3½ feet apart, and the plants should be set 24 to 30 inches apart in the row. The better practice is to top the plants before the flower head begins to bloom, and a smaller number of leaves should be left than in the case of wrapper types. The suckers must be promptly removed as they develop. The tobacco must be allowed to become full ripe, as judged by the signs indicated for the wrapper type, and should be harvested by cutting the stalk at its base and spearing it on laths, as described for Connecticut Havana Seed.

## ZIMMER SPANISH

The Zimmer Spanish variety is grown principally in the Miami Valley of Ohio. The principal soil types have been designated as "Miami clay loam," and "Miami black clay loam." The Zimmer Spanish, so called, seems to be practically identical with Havana Seed, as has already been stated. The seed beds are best sown during the latter part of March and through April. Transplanting should be done during the first three weeks of June. Commercial fertilizers should be used freely, and good results are obtained in applying as much as 1,000 pounds per acre of a mixture analyzing about 4 per cent nitrogen, 9 per cent phosphoric acid, and 8 per cent potash—

that is, one supplying about 40 pounds of nitrogen, 90 pounds of phosphoric acid, and 80 pounds of potash. Barnyard manure also gives good results. The rows should be placed 34 to 38 inches apart and the plants set 28 to 32 inches apart in the row. The plants should be topped before blooming and should be kept free from suckers. The time and method of harvesting are about the same as for Pennsylvania Broadleaf.

#### CUBAN

The Cuban variety is grown for filler leaf mainly in the southern cigar-tobacco districts. The best results are obtained on soils somewhat heavier than the types best adapted to wrapper leaf. The seed bed is burned to destroy weed seeds, as is described for the export and manufacturing types. The seed may be sown in January or February. Fertilizers are to be applied to the bed, as has been described for the cigar-wrapper type, except that potash may be omitted from the fertilizer mixture. The beds must be sprayed with Paris green or with arsenate of lead to control insects. The seedlings are ready for transplanting when they are 4 to 5 inches high. The tobacco land should be plowed in the fall and must be liberally fertilized. When 15 or 20 loads of manure per acre are applied, a mixture of 600 or 800 pounds of cottonseed meal, 400 pounds of acid phosphate, and 200 pounds of sulphate of potash usually gives good results. The rows are made 3 to 3½ feet apart and the plants are set 14 inches apart in the row. The plants should be topped to 12 to 16 leaves, and the suckers are removed as often as they appear. The tobacco should be harvested just before it becomes fully ripe. For filler leaf the proper method of harvesting is by cutting the stalk, but when there is promise of obtaining a considerable percentage of wrapper leaf the harvesting is done by picking the leaves as they ripen, in the manner described for Connecticut Havana Seed. The details of harvesting by cutting the stalk are essentially the same as for the northern wrapper varieties.

### THE CULTURE OF THE EXPORT AND MANUFACTURING TYPES

#### EXPORT AND MANUFACTURING TOBACCO VARIETIES.

White Burley is a distinctive variety, producing a type of cured leaf known by the same name, practically all of which is used in domestic manufacture. This variety, of which there are several subvarieties, such as the Stand-Up and Twist Bud, is grown mainly in north-central Kentucky, eastern Tennessee, southern Ohio, southwestern West Virginia, and southeastern Indiana. Aside from its peculiar chlorotic appearance, Burley more closely resembles the cigar seed-leaf group than the other export and manufacturing varieties (except the Maryland).

The Maryland is another fairly distinctive variety, in many respects resembling the cigar seed-leaf and White Burley varieties. The type of leaf produced is known as Maryland tobacco. Two subvarieties of the Maryland are known as Broadleaf and Narrow-leaf, respectively.

In the production of the remaining types of export and manufacturing tobaccos, such as the flue cured and fire cured, a very large number of so-called varieties are used more or less interchangeably. Nearly all of these may be regarded as coming under two principal groups, namely, Orinoco and Pryor, although in many cases the distinctions between the strains or subvarieties are so slight as to make it impossible to determine in which of the two groups each really belongs. Of the Orinoco group may be mentioned the Big Orinoco, Little or Narrow-Leaf Orinoco, White-Stem Orinoco, Lizard Tail, Gooch, and Flanagan. Among the group of Pryors there are the Blue Pryor, Yellow Pryor, White or Medley Pryor, and Silky Pryor. Two additional varieties or subvarieties of the export and manufacturing tobaccos of importance are the Yellow Mammoth and One Sucker.

#### FIRE-CURED EXPORT TOBACCO

The fire-cured export type of tobacco is grown almost exclusively in western Kentucky and Tennessee and in central Virginia. Its principal characteristics are its dark color, heavy body, and a distinctive flavor imparted to it from the smoke of the open fires used in curing. By far the greater portion of this type is exported. The soils producing the fire-cured export leaf are heavy, containing a high percentage of clay or silt, and hence would not be adapted to the culture of most other types of tobacco. The principal varieties used in producing the fire-cured tobacco are the Pryors, the Yellow Mammoth, and the Orinocos.

#### THE SEED BED

A well-drained friable soil having a southern or eastern exposure is to be preferred for the seed bed, and when practicable a suitable spot in the woods is chosen. Selecting a time, after removing the forest growth, when the soil is not too wet, it is burned to destroy weed seeds and insects. A good method is to lay small poles or skids over the area to be burned, at intervals of 3 feet, and to pile brush and wood on one end of the skids. After setting fire to the brush the burning material is pulled forward on the skids as rapidly as the soil becomes sufficiently heated and sterilized to a depth of 2 or 3 inches. After removing all débris, the soil is thoroughly spaded or plowed to a depth of a few inches. Where the necessary equipment is available the method of steam sterilization referred to on page 4 gives excellent results. Before seeding, a fertilizer consisting of about 5 pounds of cottonseed meal or 2 or 3 pounds of nitrate of soda and 1 pound of acid phosphate for each 100 square feet of bed is to be worked into the soil. In sowing the seed should be mixed with a large volume of fertilizer, corn meal, or sifted ashes (about 2 quarts for each teaspoonful of seed), in order to secure an even distribution of the seed. A heaping teaspoonful of seed is sufficient to sow 25 square yards of seed bed, and should furnish enough plants to set an acre in the field. The seed beds may be sown in January, February, or March. The seed must be covered only very lightly, and it is better simply to press the soil down firmly by trampling or with a board or roller. The bed should be surrounded with logs or boards set on edge to a

height of 6 to 10 inches to form a coldframe, over which are stretched wires to support the cheesecloth which is to be placed over the frame before the plants come up. The precautions regarding watering and hardening the plants prior to transplanting, as described for the cigar types, are to be carefully followed.

#### TRANSPLANTING AND CULTIVATING

Prior to transplanting, the land should be thoroughly fitted by plowing and harrowing, after which the rows are laid off, the preferred distance between rows being  $3\frac{1}{2}$  feet. In Kentucky and Tennessee the plants are usually set in checks; that is, they are set  $3\frac{1}{2}$  feet apart each way, whereas in Virginia they are generally spaced  $2\frac{1}{2}$  to 3 feet apart in the row. The accurate spacing of the plants may be readily attained by using a simple marking device, which is drawn across the field so as to indicate the points at which the plants are to be set. Throwing up slight ridges for the rows will remove the danger of the young plants being drowned in case of heavy rains. Transplanting is done mostly by hand and in much the same way as has been described for the cigar tobaccos. Fertilizers should be applied in the process of preparing the land for transplanting. But little barnyard manure is available in the fire-cured districts, and commercial fertilizers are generally used rather sparingly, the usual application being 200 to 600 pounds per acre of a mixture containing about 3 per cent nitrogen, 8 per cent phosphoric acid, and 3 per cent potash. Much larger quantities of fertilizer will give better results in most cases. A clover sod plowed under in the fall gives good results with this type of tobacco.

Cultivation should begin as soon as the plants start to grow and should continue as long as the size of the plants will permit. The first cultivation is deep, after which frequent shallow cultivations are most desirable. Where the plants are set in checks they may be cultivated both ways, so as to reduce the amount of hand hoeing required to keep down weeds.

#### TOPPING AND SUCKERING

When 10 to 15 leaves have appeared on the plant the top should be broken out, so as to force all the growth into the leaves left on the plant and cause them to grow larger, thicker, and darker. A favorite practice is to pick off and discard 3 or 4 of the bottom leaves, and then top the plants so as to leave 8 to 12 leaves on each plant. High topping tends to delay maturity and to produce a thinner leaf. The aim in topping is to leave only as many leaves on the plant as it can bring to the fullest development and as far as possible to insure that all plants will mature at about the same time. The suckers which develop in the axils of the leaves must be removed as often as they appear.

#### HARVESTING

The plants generally are ready for harvesting in from 30 to 40 days after topping. At this stage the leaves will have taken on a lighter color and become thick and heavy, and small yellow flecks will have appeared, especially near the edges of the leaf. It is not desirable to harvest the tobacco for two or three days after a heavy



rain, as the gum which accumulates on the leaf in dry weather and improves its quality is washed off by the rain. In harvesting, the stalk should first be split with a knife from the top down to within a few inches of the bottom, in such a way as not to cut or injure the leaves. The stalk is then cut off near the ground and laid on the ground to wilt sufficiently to permit handling without breaking the leaves. The plants should then be placed astride sticks and hauled to the curing barn. In Virginia the plants are usually placed on the sticks before being laid on the ground to wilt. The sticks are 4 feet 4 inches long, and five to eight plants, depending on their size, should be placed on each stick. The sticks carrying the plants should be arranged on the tier poles of the curing barn at intervals of 6 to 8 inches.

#### WHITE BURLEY TOBACCO

White Burley tobacco reaches its highest state of development on the limestone soils in the famous bluegrass section of Kentucky and in southern Ohio. This variety is light in color and body and possesses an exceptionally large absorptive capacity for the liquid flavoring materials used in the manufacture of plug tobacco.

The methods of preparing, sowing, and caring for the seed beds are about the same as those described for the fire-cured export tobacco. Burley tobacco gives the best results when grown on virgin soil or on a bluegrass sod which has been standing for at least six or eight years. Under these conditions two or three excellent crops of tobacco can be obtained, after which, unless root-rot resistant strains are planted, the results are unsatisfactory until the land has again stood in bluegrass for several years. In preparing the land, a bluegrass sod should be turned under in the fall and thoroughly cultivated with a disk harrow in the spring. On a heavy bluegrass sod, manure or fertilizers are seldom required for the tobacco.

Burley tobacco plants should be set 18 to 24 inches apart in the row, with the rows  $3\frac{1}{2}$  feet apart. Transplanting by machine has proved very satisfactory. Cultivation should be shallow, frequent, and thorough. The tobacco must be topped comparatively high, from 14 to 18 leaves being left on the plant. Careful attention must be given to the removal of the suckers. The crop should be harvested in the same manner as the fire-cured export tobacco, except that when cut it is preferred that the plants be immediately placed astride the stick, one end of which is forced into the ground at an angle in such a position that the stick bearing the plants rests on the stubble of a severed plant. The tobacco is to be left in this position till wilted and then carried to the curing barn. The sticks bearing the plants should be placed 8 to 10 inches apart on the tier poles.

#### FLUE-CURED TOBACCO

The flue-cured type of tobacco, frequently spoken of as bright tobacco, is grown extensively in the eastern counties of South Carolina, in the northern and eastern counties of North Carolina, and in southern Virginia, and more recently has been successfully introduced into south-central Georgia and northern Florida. It is used largely in the manufacture of cigarettes, smoking and plug tobacco, and for export. The bright color of the leaf is due mainly to the character of the

soil upon which it is grown and to the method of curing. The typical soils are light sands and sandy loams with yellow or red sandy and sandy-loam subsoils containing relatively small proportions of clay, except in the Piedmont region, where the subsoil is distinctly clayey. The varieties most used in growing flue-cured tobacco are strains or subvarieties of the Orinoco and the Pryor groups, such as Little Orinoco, Big Orinoco, Warne, Gooch, Adcock, Yellow Pryor, and Flanagan.

The methods of preparing and caring for the seed beds and fitting the land are essentially the same as for the fire-cured export tobacco. The rows should be laid off  $3\frac{1}{2}$  or 4 feet apart and the plants set 24 to 36 inches apart in the row. Transplanting should begin about the first of April in South Carolina and Georgia and extend into May or even June in the western portions of the North Carolina district. The bright-yellow color of this type is one of its most valued characteristics, and for this reason large quantities of nitrogenous fertilizers must be avoided. The soils producing the best quality of leaf are naturally infertile, and commercial fertilizers are freely used with profit, although the proportion of nitrogen in the fertilizers must be kept comparatively low.

In the eastern or Coastal Plain portion of the flue-cured district, where the soils are generally more sandy, a somewhat heavier rate of application of fertilizer is required than in the Piedmont region. Acid phosphate is a suitable source of phosphoric acid in the fertilizer. It is recommended that one half of the nitrogen or ammonia of the fertilizer be derived from nitrate of soda or urea and the remaining half from two or more standard organic sources, such as fish scrap, cottonseed meal, and dried blood. Ammonium sulphate may be used to replace one-half the nitrate of soda or urea. As a source of potash, high-grade muriate may give a somewhat better yield of tobacco than does the sulphate; but since the former contains a high percentage of chlorine, which may injure the combustibility of tobacco if absorbed by the plant in considerable quantity, it is perhaps safer to use muriate as the source of not more than 40 pounds of potash per ton of fertilizer. If muriate of potash is used, it is recommended that the high-grade salts be employed. The use of sulphate of potash-magnesia in the fertilizer has the advantage of furnishing both potash and magnesia. (See p. 21.) For average conditions a combination of the above-named materials in quantities sufficient to furnish the equivalent of 800 to 1,000 pounds per acre of a fertilizer analyzing 8 per cent phosphoric acid, 4 per cent ammonia, and 6 per cent potash is recommended for the Coastal Plain section. For the Piedmont section a mixture of these materials equivalent to 800 pounds per acre of a fertilizer of the same analysis, or one containing somewhat less ammonia and potash, is suggested. A mixture of 500 pounds of 16 per cent acid phosphate, 110 pounds nitrate of soda, 90 pounds of fish containing 11 per cent ammonia, 125 pounds of cottonseed meal, 40 pounds high-grade muriate, and 80 pounds sulphate of potash or 150 pounds sulphate of potash-magnesia would supply the quantities of the phosphoric acid, ammonia, and potash called for in the heavier rate of fertilizing. Under some conditions the application of lime to tobacco lands may be beneficial to other crops grown in the rotation, but the direct effect of lime on the tobacco crop may be somewhat

injurious except where dolomitic limestone is used to supply magnesium as a remedy for the sand-drown disease. Light applications of well-rotted manure in the fall or early spring are beneficial as a supplement to commercial fertilizer.

The methods of cultivation are similar to those used for fire-cured tobacco. When the flower heads begin to show, the plants are topped. In the Piedmont section 8 to 12 leaves are left on the plant, depending on the richness of the soil and the vigor of the plant. In the Coastal Plain section the plants are topped somewhat higher, leaving 12 to 16 or 18 leaves to the plant. The suckers must be removed at intervals of a week or 10 days, and it may be necessary to go over the field five or six times.

Flue-cured tobaccos should be thoroughly ripe when harvested. The leaf surface should show numerous patches of a light-yellow color, and even the green portions should be of a light tint; otherwise it will be difficult or impossible to cure the leaf properly. In the eastern portion of the flue-cured districts the preferred method of harvesting is to pick off the leaves as they ripen, beginning at the bottom of the plant and taking two or three leaves at each picking. The leaves should be taken to the barn and attached in small bunches to the sticks by means of strings. The string is attached to an end of the stick and near this end is passed once around the stems of three to five leaves, thus forming a small bunch which will hang to one side of the stick. The string is then drawn diagonally to the opposite side of the stick and similarly looped around a second bunch of leaves and the process repeated until the stick is full, when the free end of the string is attached to the other end of the stick. In the western portion of the flue-cured district the method formerly used was to harvest the tobacco by splitting the stalk, cutting it off at the base, and placing it astride the stick, as in the case of fire-cured and Burley tobacco. In recent years, however, harvesting by picking the leaves has been extensively practiced in the western portion of the flue-cured district. The field must be gone over from two to four times in order to get all of the plants at the right stage of ripeness.

#### DARK MANUFACTURING TOBACCOS

In the portion of Kentucky and Tennessee lying between the Burley district and the dark fire-cured sections, types of tobacco are produced in large quantities suitable for domestic manufacture into chewing and smoking tobacco. These types are mostly air cured, like Burley, but in other respects the methods of production are quite similar to those followed for the dark fire-cured tobacco. In the southern portions of this territory, centering around Warren County, Ky., the so-called One Sucker is the principal variety grown.

In the few counties of Virginia in the vicinity of Richmond a type of leaf long known as Virginia Sun-Cured is produced. Formerly the tobacco was exposed to the sun in the process of curing (hence the name), but at the present time air curing as practiced in the Burley district is the more common method. This type is specially adapted to the manufacture of chewing tobacco. Aside from the curing and somewhat higher topping, substantially the same methods of production should be followed as have been outlined for the fire-cured export tobacco.

## MARYLAND TOBACCO

The Maryland type is produced extensively in the section lying between the Potomac River and Chesapeake Bay known as southern Maryland. This tobacco is light in body and color, of a dry or chaffy character, and has good burning qualities. Maryland tobacco is an export type and goes mostly to France, the Netherlands, and Germany, although in recent years it is being used more and more in the domestic manufacture of cigarettes. The broadleaf varieties do best on light land, whereas the narrowleaf sorts are grown mostly on the heavier soils. The Maryland Mammoth variety gives large yields and excellent quality on the more productive soils but is not profitable on land of medium or low productivity.

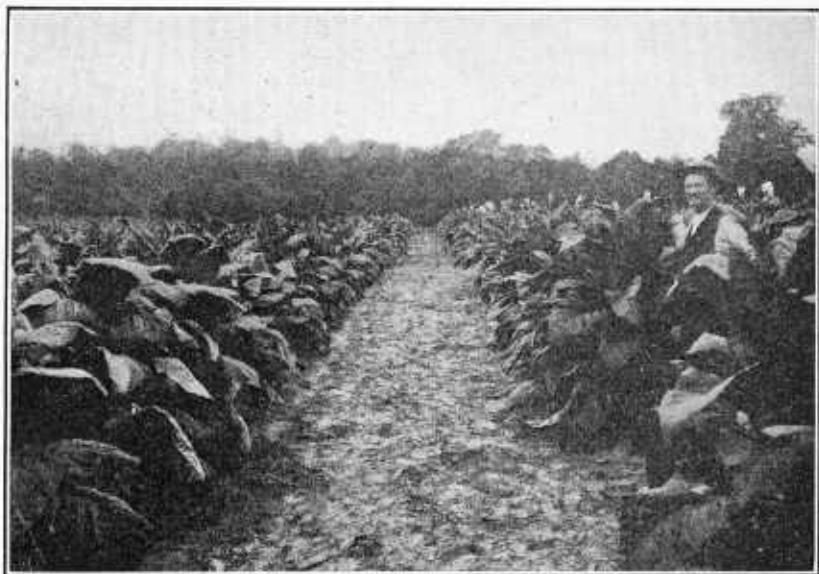


FIG. 4.—Field of tobacco in Maryland which has been topped and is nearly ready for harvesting. On the right are shown seed heads of selected plants covered with bags to prevent crossing

The tobacco soils of Maryland are sandy or silty in character, the soil and subsoil being gray or yellow in color, and are usually deficient in humus. When available, stable manure gives good results. The use of commercial fertilizers is increasing. For average conditions 500 pounds per acre of a fertilizer analyzing 6 per cent ammonia, 8 per cent phosphoric acid, and 6 to 10 per cent potash gives good results.

The tobacco may be conveniently set in squares, the plants being spaced 32 to 36 inches apart each way. Cultural methods are about the same as for other types. The plants are topped at 16 to 20 or more leaves, depending on the vigor of the plants and the seasonal conditions. The tobacco matures in two to four weeks after topping, and should be harvested by cutting the stalk and spearing on a stick, as described for the cigar-leaf types. A field of Maryland tobacco nearly ready for harvesting is shown in Figure 4.

## TOBACCO DISEASES

The tobacco plant is attacked by a number of diseases, but only some of the more important ones can be considered in this bulletin.

## ROOT-ROT

One of the most important and widespread diseases affecting the plant is known as black root-rot. Usually this disease can be readily recognized by carefully examining the roots, which are seen to be more or less decayed, the smaller roots especially showing blackened portions. The plants do not start to grow properly and may wilt in sunshine even though the soil is moist. The symptoms above ground often merely suggest an infertile soil, need of fertilizer, too much water, and the like. This disease is due to a fungus (*Thielavia basicola*), which persists in the soil from year to year and in addition to tobacco attacks cowpeas, the clovers, and other legumes. Cool weather, such as occurs in a late wet spring, greatly favors the disease, while very hot weather may soon check it, causing the plants to develop new roots near the surface of the ground, where the soil is warmest, and to begin growing.

The disease may be controlled in the seed bed by sterilizing the soil through the use of steam or of formaldehyde, as described in Farmers' Bulletin 996, entitled "Steam Sterilization of Seed Beds for Tobacco and Other Crops." Diseased seedlings should never be set in the field, for this may be a means of spreading the trouble. The ordinary varieties of White Burley tobacco are very susceptible to the disease, but highly resistant strains of Burley as well as of some of the northern cigar-tobacco varieties have been developed recently and may be successfully grown on diseased land. Resting the land for several years or the rotation of crops (avoiding legumes) will tend to reduce the injury from root rot.

In southern tobacco districts areas of varying size may be seen on which tobacco plants make very little growth, though other crops may grow satisfactorily. These so-called dead spots, which persist from year to year, are not improved by liming or fertilizing. The roots of the tobacco plants do not show the black-rot characteristic of the preceding disease, but have a yellowish color instead of the normal white color of healthy roots. No specific remedy for this disease has been developed, although addition of organic matter to the soil has proved very beneficial in some cases.

## THE TOBACCO WILT (GRANVILLE WILT)

Tobacco wilt, or the Granville wilt of tobacco, is a serious bacterial disease which attacks a number of plants besides tobacco. The germ enters the plant through the roots and multiplies so rapidly that the water-conducting vessels become plugged, causing the leaves to wither and perish. The woody portion of the stalk shows a yellowish to black streak when the bark is stripped off. The disease occurs chiefly in Granville County and the adjoining counties of North Carolina and in the cigar-tobacco district of western Florida. Fertilizers have nothing to do with the occurrence of the wilt. The systematic and persistent rotation of crops is the only successful method

of combating the disease. Crops which are attacked should not be planted, and tobacco must not be grown on the land oftener than once in four or five years. Corn, cotton, sweet potatoes, redtop or herd's-grass, and other grasses, cowpeas, wheat, oats, rye, and the clovers are immune and may be used in the rotation. Resting the land will not give good results, because ragweed, which is so common on tobacco fields, is attacked by the wilt organism.

#### ROOT-KNOT

Tobacco may be severely injured on light sandy soils in the South by a minute eelworm or nematode which bores into the roots, causing them to develop galls or swellings; hence the name "root-knot," commonly applied to this trouble. The disease is easily recognized by examining the roots. The growth of the plant is retarded and in some cases the leaves turn yellow. This disease is readily controlled by rotation of crops, provided the highly resistant crops are used and a crop of tobacco is grown only every third or fourth year. The Iron and Brabham varieties of cowpeas, velvetbeans, corn, wheat, oats, rye, sorghum, peanuts, and grasses may be used in the rotation, but most other crops, including the ordinary varieties of cowpeas, should be avoided.

#### SORE-SHANK

In the fungous disease known as "sore-shank" the stem of the plant undergoes a decay at the surface of the ground and usually the plant finally topples over. There may be no indication of the disease to the casual observer until the plant suddenly withers or is blown over by the wind. As a rule, damage from this disease is small, since only a plant here and there in the field is affected. Occasionally a peculiar wilting and dying of the lower leaves, perhaps only the portion of the leaf on one side of the midrib being affected, is seen in this disease. If the trouble becomes serious, rotation of crops may be resorted to as a remedy.

#### MOSAIC, CALICO, OR WALLOON

One of the most widespread maladies of the tobacco plant is known as mosaic, calico, or walloon. The chief symptom is a mottling of the leaf, portions of which are of a lighter green color than the remaining portions, and this mottling may extend also to the blossoms. In severe cases of the disease there may be various malformations and distortions of the leaves. The disease is highly infectious and may be communicated from diseased to healthy plants by laborers in transplanting, topping, or suckering, and by insects. Tobacco plants are seldom killed by mosaic, but both the yield and the quality of the crop may be injured. The disease may be carried over in the soil. Care should be taken to avoid spreading it by handling healthy plants after having touched diseased ones. The first source of infection in the spring is not known, but it has been found that certain species of plant-lice and flea-beetles are partly responsible for disseminating the disease.

## FRENCHING

Another disease frequently confused with mosaic is properly known as "frenching." This disease is not infectious and is due to some unfavorable condition of the soil. In severe cases the leaves of the plant are so long and narrow that they may be spoken of as stringy or ribbonlike, and they are extremely thick and brittle. In milder forms of the malady the leaves are small, narrow, stiff, and stand up in an erect manner. The upper surface of the young leaves shows numerous golden yellow spots, and the leaves are thick. The disease may occur at any stage of development, and often only the upper part of the plant is affected. Defective drainage seems to be a contributory cause of the disease, and it appears that deficiencies in plant food may cause symptoms of the trouble. Correction of the cause of the trouble often leads to the recovery of the plants.

## LEAF-SPOT DISEASES

A number of different names have been applied to the leaf-spot diseases of tobacco which have appeared in severe form from time to time in different tobacco-growing sections. Among these names may be mentioned "blight," "fire," "red-fire," "wild-fire," "red rust," "brown rust," "speck," and "angular leaf-spot." It appears that there are several distinct leaf-spot diseases, most of which are due to fungi and bacteria. Observation shows that most, if not all, of these diseases develop in severe form only under a special combination of conditions, so that in any particular locality they are not likely to prove especially destructive, except in certain years and often at rather infrequent intervals. Broadly speaking, the so-called rusts have been most prevalent in northern cigar-tobacco districts, and the red rust or brown rust frequently follows as a sequel to the mosaic disease. The so-called wild-fire and the angular leaf-spot, which are very similar diseases, have caused considerable damage in various districts during the last few years. Both are bacterial diseases. They usually appear first in the seed bed, but the materials chiefly responsible for carrying the bacteria through the winter are not definitely known. As an aid in preventing infection in the seed bed it is recommended that the seed be sterilized by soaking for exactly 15 minutes in a solution of 1 part corrosive sublimate (bichloride of mercury) in 1,000 parts water. The solution should be prepared in a glass or wooden vessel. After treatment the seed must be washed thoroughly and dried promptly at ordinary room temperatures. Corrosive sublimate may be purchased in tablet form at drug stores, and directions for making the solution of proper strength accompany the package. (It is to be remembered that *this substance is a deadly poison* if taken internally and its use should be properly safeguarded.) The soil of the seed bed should be sterilized by steaming or by thorough surface burning, and the frames and covers may be treated with formaldehyde or steam. Care should be taken to prevent any tobacco trash from infected crops or other organic matter likely to harbor the germs of the disease from reaching the seed bed. No specific remedy for these diseases has been found, once they have attacked the plant, but dry weather

usually checks their progress. The tobacco plant is subject to attack at any stage of development, but seems to be particularly susceptible at the time it reaches maturity. The diseases are more destructive in periods of wet weather, and their progress may be rapidly checked by dry clear weather. An abundant supply of nitrogen in the soil or fertilizer and low topping of the plants are predisposing factors toward injury from these leaf-spots, while a liberal supply of potash in the fertilizer tends to increase the resistance of the plants to the diseases.

#### POTASH HUNGER

An insufficient supply of potash in the soil for normal growth and development of the tobacco crop usually produces characteristic symptoms in the leaf which are easily recognized by those familiar with the disease. First indications of this trouble are usually seen on the tips and margins of the lower leaves, but in some cases the tips of the middle leaves are first affected. Beginning at the tip a chlorosis or yellowing of the leaf surface develops, which is often followed by the appearance of numerous small specks of dead tissue. The growth of the leaf is uneven, and the surface becomes rough and puckered, the slower growth of the tip and edges causing a characteristic curving downward of these portions. As the disease progresses the margins of the leaf may become torn and ragged, and large splotches of dead tissue develop over the surface. In severe cases the portions of the leaf which remain green assume an abnormally dark, muddy, bluish green shade. This disease, which is readily controlled by using an adequate supply of potash in the fertilizer, is more commonly seen on light sandy and sandy loam soils, especially in the Coastal Plain portion of the flue-cured district.

#### MAGNESIA HUNGER (SAND-DROWN)

On some of the light sandy and sandy loam tobacco soils, more especially in seasons of heavy rainfall, pronounced symptoms of disease, due to an insufficient supply of magnesia, make their appearance. This disease is commonly known as sand-drown, because it is likely to be more severe on sandy spots in the field and after heavy rains. Some care is required to distinguish between the symptoms of sand-drown and those of potash hunger, since both may occur on the same soil and even on the same plants. Sand-drown always begins on the lower leaves and at the tips and along the margins of the leaves. The green color is bleached out, leaving the affected leaf surface almost white. Ordinarily the leaf surface remains smooth, and there is less tendency toward spotting or specking than in potash hunger. The leaf margin does not curve downward, as in potash hunger, but in some cases may turn upward. The use of a fertilizer supplying 10 to 20 pounds of magnesia per acre in available form, if applied in the drill, usually suffices for the control of magnesia hunger. Sulphate of potash-magnesia is suitable for this purpose. Dolomitic limestone (high in content of magnesia) applied in the drill at the rate of 1,000 pounds or broadcast at the rate of 2,000 pounds or more is effective. Fertilizers of vegetable origin, such as cottonseed meal and tobacco stems, and manure also tend to prevent the disease.



## INSECT ENEMIES OF TOBACCO

One of the most troublesome and expensive features of tobacco culture, particularly in the southern districts, is the control of numerous insects, which if not combated would oftentimes completely destroy the commercial value of the crop. Among the more important insects attacking the tobacco plant may be mentioned the tobacco flea beetle, the tobacco "wireworm," cutworms, the hornworms, or "green worms," and the tobacco budworm. Of these the hornworms, or "green worms," are usually the most destructive.

For detailed information regarding insects attacking tobacco and methods of combating them, the reader is referred to bulletins on this subject issued by the United States Department of Agriculture.

## SELECTING SEED PLANTS AND SAVING THE SEED

The first step in producing a satisfactory crop of tobacco is to use good seed, true to type, and before topping is done the tobacco field should be gone over carefully in search of desirable seed plants. Having definitely decided upon the ideal type of plant desired, only those plants which conform to this type should be selected for growing seed. The advantages of selecting good seed plants will be lost if crossing with other types is allowed to take place. This is prevented readily by covering the flower head with a 12-pound manila paper bag in the manner shown on the title-page of this bulletin. The small leaves and branches just below the flower head proper should be removed and the mouth of the bag securely tied to the stalk just below the flowering branches. Any blossoms which have already opened must be picked off before the bag is placed in position. The bag must be adjusted from time to time to accommodate the growth of the flower head.

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